

Multidisciplinary efforts focus on polymer aging

Polymer aging is a crucial materials issue in the weapons stockpile and in industry, and Los Alamos has several related efforts underway to investigate this issue. The Materials Science and Technology Division (MST) participates in a multi-divisional Laboratory Directed Research and Development (LDRD) effort to develop not only an understanding of the interaction of polymer aging mechanisms with physical properties, but also predictive models that can span material lifetimes as long as fifty years. A key issue in this endeavor is the ability to perform accelerated aging without changing the mechanistic processes that occur in a normal use lifetime. The Polymers and Coatings Group (MST-7) serves as the core materials resource on this project--we provide polymer characterization and develop aging methodologies in conjunction with the Weapon Materials and Manufacturing Group (ESA-WMM).

Complementary to our LDRD effort is work in support of enhanced surveillance. We are investigating stockpile return samples to determine the current status of their viscoelastic properties and to develop hypotheses on principal degradation pathways. We are collaborating with the Engineering Sciences and Applications (ESA) and Dynamic Experimentation (DX) divisions on lifetime prediction of the explosive known as PBX 9501. In this program, we are using specialized methods to assess the performance degradation of the explosive material over time. The composite nature of PBX complicates the possible material interactions that could lead to significant material degradation. Models and analysis from ESA, Theoretical, and Technology and Safety Assessment divisions will produce a higher confidence prediction of useful lifetime. Nondestructive analytical methods for PBX 9501 and other explosives are needed. We are working with the High Explosive Science and Technology Group (DX-2) to investigate dielectric relaxation analysis as a nondestructive test method for PBX 9501 and other high explosives.

We also participate in other collaborative efforts with DX Division, Manuel Lujan Jr. Neutron Scattering Center, and the Ceramics Science and Technology Group (MST-4) on neutron scattering by Estane, the polymeric binder of PBX 9501. In this project, we seek to develop an in-depth understanding of the binder interaction with the energetic material. Other weapons related work includes a study on the stabilization of Estane. This material has been monitored for a year in a battery of twenty different formulations of stabilizers and additives. We have determined that several formulations systems are not useful for long term applications, while several are as stable or perhaps better than the current formulations.

The starting materials for some of the original polymeric materials in the stockpile are no longer available and replacement materials are needed. Therefore, we are working with ESA-WMM and Allied-Signal, Kansas City Plant on finding a replacement for a silicone foam resin. We have identified several materials and are currently working on qualifying the properties against the original resin.

For more information, contact Los Alamos' Transportation Program:

Program Manager: Larry Blair

Phone: 505-667-1936

Fax: 505-665-2964

E-mail: lblair@lanl.gov

Program Development: Linda Rowton

Phone: 505-665-3322

Fax: 505-665-2964

E-mail: lrowton@lanl.gov
